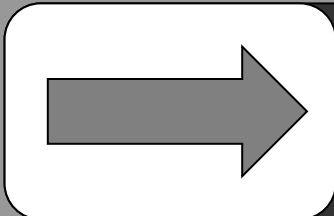


Wed Oct 8th 2014.

CIVL 498C Life Cycle Assessment

Week 6: Inventory Analysis Benchmarking Exercise



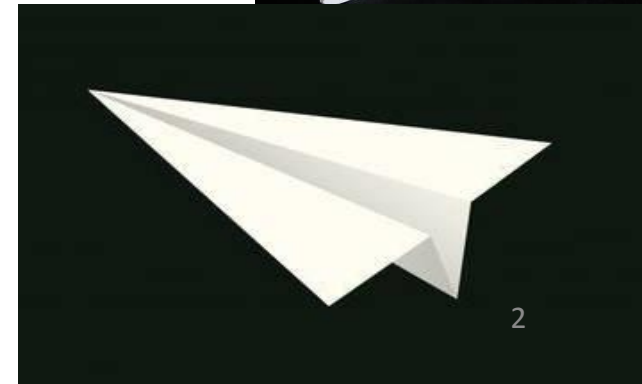
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Hands on Inventory Analysis Exercise

Spheres and Planes



08/10/2014



Inventory Analysis Exercise Directions

Exercise Materials:

1. Exercise Directions
2. Data Collection Sheets
3. Data Processing Sheets

Your air travel company offers two air travel services by airplane and by sphere to destinations all over the globe. Your customers want to make more sustainable travel choices to minimize their time impact. Keen to help them, your company decides to carry out a cradle-to-grave life cycle inventory (LCI) study to determine the time needed to provide each travel service option. Carry out the following directions with your air travel company team members.

1. Come up with a name for your air travel company and define Goal parameters for your company's LCI study.
 - a. Intended application? _____
 - b. Reason for carrying out the study? _____
 - c. Intended audience? _____
 - d. Intended for comparative assertions? _____
2. Read the directions for the Unit Processes on the *data collection sheet* provided.
3. Create a process flow diagram that illustrates the structure and relationship between the Airplane and Sphere product systems. Include unit processes as boxes, products/co-product flows with arrows to indicate the direction of their product flows, and the system boundary as a dashed line.
 - a. What is an appropriate functional unit of the product system supported by your air travel company's services? _____
4. Assign one group member as the Timer and assign the rest of the life cycle modules to the other group members.
5. Starting from Raw Material Acquisition Stage – the Timer begins timing their group members in sequence as they carry out the respective Unit Process directions, from Raw Material Acquisition to End-of-Life Stage. The Timer records the times for the respective Unit Processes in the *data collection sheet* provided. NOTE: This also includes recording distance travelled in the Use stage.
6. Once all stages are complete. Identify where inventory flows share Unit Processes, and apply a mass allocation procedure to the shared inventory flows in the Sphere and Airplane Product Systems. Assume your extracted piece of paper weighs 1kg, and make note of the allocation factors used.
7. Relate inventory flows using your functional unit and record your final allocated and functional unit related inventory analysis results in the final columns of your data processing sheet.
8. Aggregated (ie. sum) the inventory results for each life cycle module and for your Airplane and Sphere product systems.

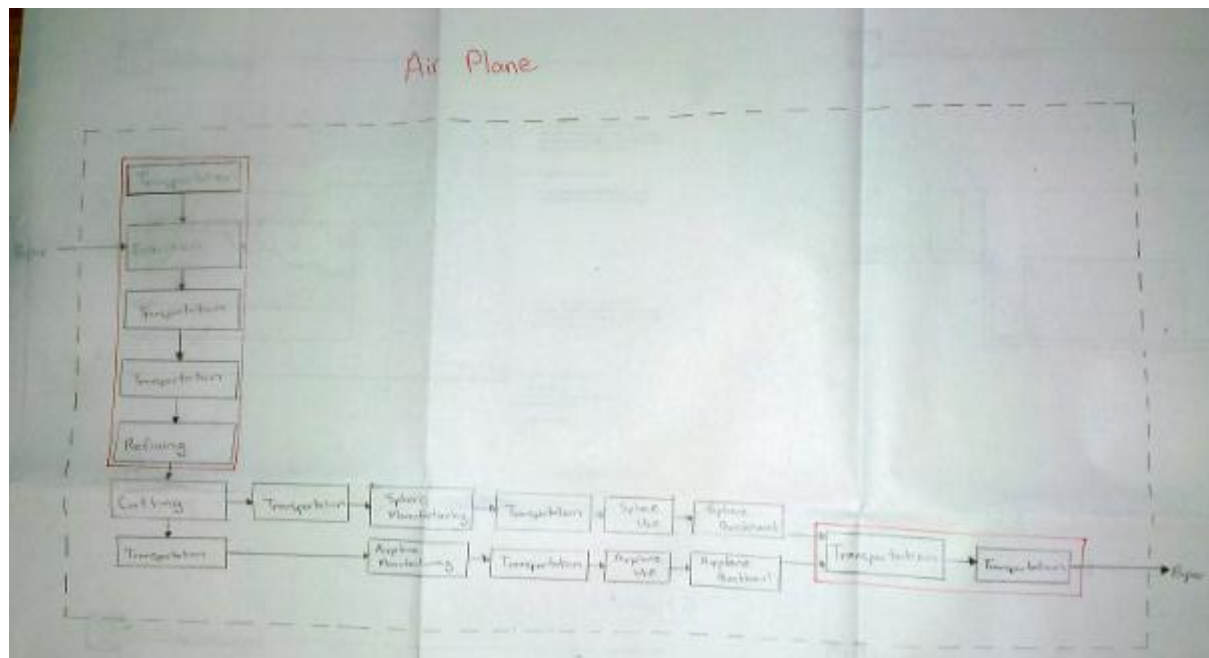
Dewei Kong 71685194

October 1st, 2014.

Inventory Analysis Exercise Directions

Your air travel company offers two air travel services by airplane and by sphere to destinations all over the globe. Your customers want to make more sustainable travel choices to minimize their *time* impact. Keen to help them, your company decides to carry out a cradle-to-grave life cycle inventory (LCI) study to determine the time needed to provide each travel service option. Carry out the following directions with your air travel company team members.

1. Come up with a name for your air travel company and define Goal parameters for your company's LCI study.
 - a. Intended application? To make travel choices with minimized time.
 - b. Reason for carrying out the study? To determine the time needed to provide each travel service option
 - c. Intended audience? Customers
 - d. Intended for comparative assertions? Yes
2. Read the directions for the Unit Processes on the *data collection sheet* provided.
3. Create a process flow diagram that illustrates the structure and relationship between the Airplane and Sphere product systems. Include unit processes as boxes, products/co-product flows with arrows to indicate the direction of their product flows, and the system boundary as a dashed line.
 - a. What is an appropriate functional unit of the product system supported by your air travel company's services? Seats
4. Assign one group member as the Timer and assign the rest of the life cycle modules to the other group members.
5. Starting from Raw Material Acquisition Stage – the Timer begins timing their group members in sequence as they carry out the respective Unit Process directions, from Raw Material Acquisition to End-of-Life Stage. The Timer records the times for the respective Unit Processes in the *data collection sheet* provided. NOTE: This also includes recording distance travelled in the Use stage.
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8. Aggregated (ie. sum) the inventory results for each life cycle module and for your Airplane and Sphere product systems.



Extraction	
→ TRANSPORTATION	7.1 sec
→ EXTRACTION	11.0 sec
→ TRANSPORTATION	11.8 sec

REFINING	
→ TRANSPORTATION	10.7 sec
→ REFINING	14.0 sec
→ CUTTING	33.6 sec

ALLOCATION FACTOR
2/3 AIRPLANE
1/3 SPHERE

AIRPLANE SPHERE MANUFACTURING	
→ TRANSPORTATION	213s
→ SPHERE MANUFACTURING	42s

SPHERE USE	
→ TRANSPORTATION	18.3s
→ SPHERE USE	5.98s
→ SPHERE BACKPACK	1.02s

AIRPLANE MANUFACTURING	
→ TRANSPORTATION	130s
→ AIRPLANE MANUFACTURING	12.5s

AIRPLANE USE	
→ TRANSPORTATION	9.0s
→ AIRPLANE USE	4.0s
→ AIRPLANE BACKPACK	1.0s

RECYCLING	
→ TRANSPORTATION	11.5s
→ TRANSPORTATION	12.0s

ATMOSPHERE INC.

FUNCTIONAL UNIT

TIME
distance

Area

AIRPLANE TIME =

$$\frac{2}{3} (7.1 + 11.0 + 11.8 + 10.7 + 14.0 + 33.6 + 18.3 + 5.98 + 1.02)$$

$$+ 13.0 + 12.5 + 9.0 + 4.0 + 1.0 = 157.6$$

$$\text{STEPS} = 157.6 \div 16 = 9.85 \text{ min}$$

SPHERE TIME

$$\frac{1}{3} (7.1 + 11.0 + 11.8 + 10.7 + 14.0 + 33.6 + 18.3 + 5.98 + 1.02)$$

$$+ 21.3 + 4.2 + 2.5 + 1.0 = 94.88$$

$$\text{STEPS} = 94.88 \div 16 = 5.93 \text{ min}$$

$$\text{AIRPLANE} \rightarrow 6.54 \frac{\text{step}}{\text{day}}$$

$$\text{SPHERE} \rightarrow 3.25 \frac{\text{step}}{\text{day}}$$

Method Overview

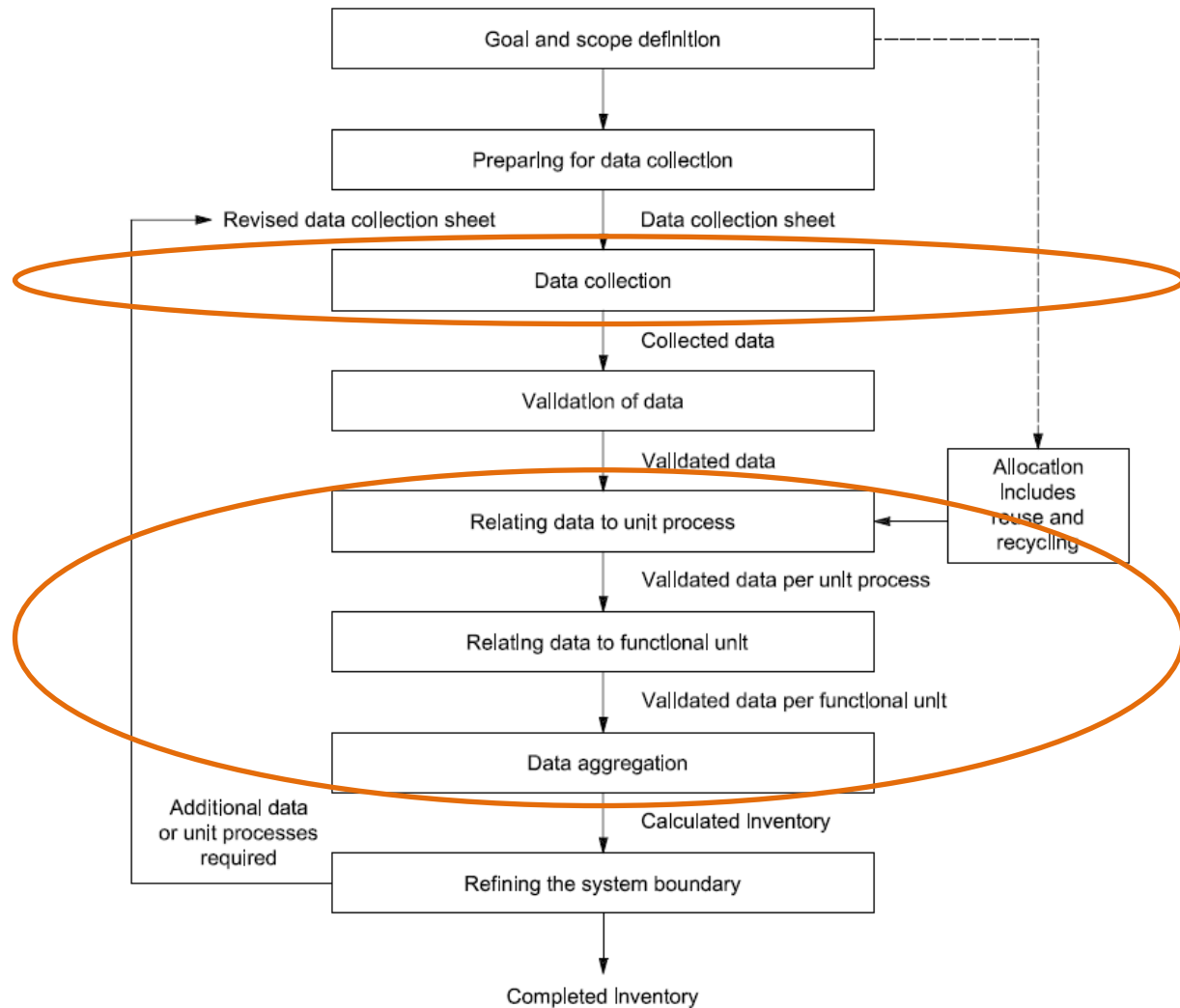


Figure 1 — Simplified procedures for inventory analysis

Kyle Schumann

Air Travel Company Name: Air Plane

RAW MATERIAL ACQUISITION STAGE

Extraction Module

Unit Process Name	Directions	Inventory Data Results (total seconds to complete task)
Transportation	Walk over to recycling/waste bin.	15
Extraction	Pull out 1 sheet of paper.	4
Transportation	Walk back to your original position.	15

MANUFACTURING STAGE

Refining Module

Unit Process Name	Directions	Inventory Data Results (total seconds to complete task)
Transportation	Walk over to the waste bin, pick up the folded sheet of paper. Walk back to original position.	12
Refining	Fold each piece of paper so it has a single fold at the 1/2 length mark. Write "Sphere" on the 1/2 area and "AIRPLANE" on the 1/2 area.	20
Cutting	Cut each piece of paper along the 1/2 length mark.	14

Kyle Schumann

physical basis for allocation

Aggregated results

Air Travel Company Name: Air Plane

RAW MATERIAL ACQUISITION STAGE

Extraction Module

	Sphere	Airplane
Allocation Factor	<u>1/3</u>	<u>2/3</u>

Inventory Data Results (total seconds to complete task)

	Sphere	Airplane
Transportation	5	10
Extraction	1.33	2.67
Transportation	5	10

MANUFACTURING STAGE

Refining Module

	Sphere	Airplane
Transportation	4	8
Refining	6.67	13.33
Cutting	4.67	9.33

Inventory Data Results (total seconds to complete task)

	Sphere	Airplane
Transportation	1.5	1.14
Refining	0.83	1.9
Cutting	0.58	1.33

Total

Sphere: 1.43
Airplane: 3.24

Airplane Manufacturing Module

Unit Process Name	Directions	Inventory Data Results (total seconds to complete task)
Transportation	Walk over to Refining, pick up sheet of paper that says "AIRPLANE" and walk back to original position.	12
Airplane Manufacturing	Turn the piece of paper into an airplane.	30

USE STAGE

Sphere Use Module

Unit Process Name	Directions	Inventory Data Results (total seconds to complete task)	Reference (rounded to 2 decimal)
Transportation	Walk over to Refining, pick up sheet of paper that says "SPHERE" and walk back to original position.	18	
Sphere Use	Place Sphere as far as you can.	2	8
Sphere Backhaul	Return Sphere to Refining and return to position you threw it from.	9	16

Airplane Use Module

Unit Process Name	Directions	Inventory Data Results (total seconds to complete task)	Reference (rounded to 2 decimal)
Transportation	Walk over to Airplane Manufacturing, pick up Airplane and walk back to original position.	19	
Airplane Use	Throw Airplane as far as you can.	3	7
Airplane Backhaul	Return Airplane to Airplane Manufacturing, pick up Airplane from where it landed and return to position you threw it from.	6	14

delivered performance

MANUFACTURING STAGE

Sphere Manufacturing Module

Unit Process Name	Directions	Inventory Data Results (total seconds to complete task)
Transportation	Walk over to Refining, pick up sheet of paper that says "SPHERE" and walk back to original position.	12
Sphere Manufacturing	Turn the piece of paper into a sphere.	3

Airplane Manufacturing Module

Unit Process Name	Directions	Inventory Data Results (total seconds to complete task)
Transportation	Walk over to Refining, pick up sheet of paper that says "AIRPLANE" and walk back to original position.	12
Airplane Manufacturing	Turn the piece of paper into an airplane.	34

USE STAGE

Sphere Use Module

Unit Process Name	Directions	Inventory Data Results (total seconds to complete task)	Reference (rounded to 2 decimal)
Transportation	Walk over to Refining, pick up sheet of paper that says "SPHERE" and walk back to original position.	18	
Sphere Use	Place Sphere as far as you can.	2	8
Sphere Backhaul	Return Sphere to Refining and return to position you threw it from.	9	16

Airplane Use Module

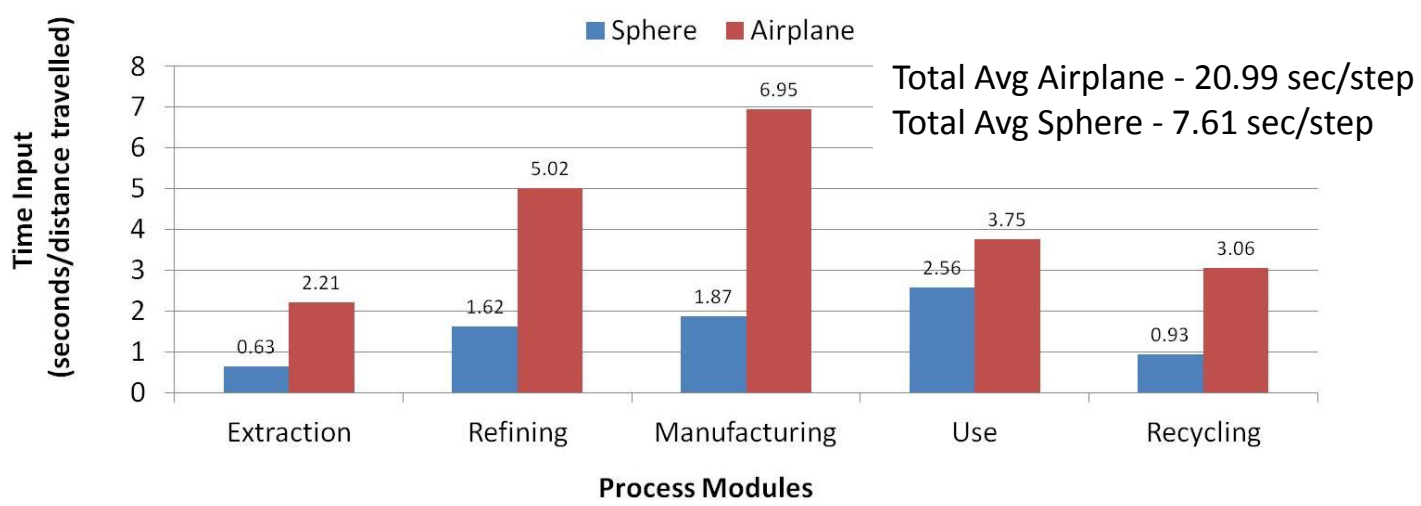
Unit Process Name	Directions	Inventory Data Results (total seconds to complete task)	Reference (rounded to 2 decimal)
Transportation	Walk over to Airplane Manufacturing, pick up Airplane and walk back to original position.	19	
Airplane Use	Throw Airplane as far as you can.	3	7
Airplane Backhaul	Return Airplane to Airplane Manufacturing, pick up Airplane from where it landed and return to position you threw it from.	6	14

What if...

Intended application –
to inform and manage
strategies to reduce
'time' (impacts..).

2013 CIVL 498C Airplane and Sphere Benchmarks*

*Benchmarking is referred to as 'Normalization' in ISO 14044 under 'Optional elements of LCIA'.



Life Cycle Module	Sphere Product System		Airplane Product System	
	% Difference from Benchmark	Hotspot Unit Processes	% Difference from Benchmark	Hotspot Unit Processes
Extraction				
Refining				
Manufacturing				
Use				
Recycling				
Overall				

- 1. **Reduction Strategy** - What strategies could your company use to end up with a lower time spent overall, and in each of the Hotspots?
- 2. **Data Inconsistencies** – In what ways could air travel companies have collected data differently to make their results look better than they really are?